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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 10/040,378 | 01/09/2002 | Daisuke Komada | 107317-00040 | 5475 |

7590 05/07/2003

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| EXAMINER | |
|---|---|
| VINH, LAN | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 1765 | |

DATE MAILED: 05/07/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/040,378 | KOMADA, DAISUKE | |
| | Examiner | Art Unit | |
| | Lan Vinh | 1765 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *09 January 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. *10/040378* .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

## DETAILED ACTION

### *Information Disclosure Statement*

1. The Information Disclosure Statement (IDS) filed on 1/9/2002 has been considered. The PTO form 1449 is enclosed in this office action.

### *Claim Rejections - 35 USC § 112*

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 4, 5, 10, 14, 15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 4, 5, 10, 14, 15 are indefinite for use of improper Markush language. The examiner suggests replacing "a" with --the--.

### *Claim Rejections - 35 USC § 103*

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1, 2, 4, 5, 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al. (US 6,380,096) in view of Yanagida (US 5,338,399)

Hung discloses an in situ oxide etch process particularly useful for a counterbore dual-damascene structure. This process comprises the steps of:

forming a mask pattern 98 over an dielectric layer 14 (silicon oxide) (col 9, lines 1-9, fig. 5), which reads on covering a surface of an insulating film made of silicon-containing insulating material with a mask pattern

etching the dielectric layer 14 using mask pattern 98 as a mask and etching gas contains $C_4F_8$ and another fluorocarbon gas (col 5, lines 30-50, fig. 6)

Unlike the instant claimed invention as per claim 1, Hung fails to disclose using an etching gas contains $C_4F_8$ and $C_xF_y$ gas (wherein x is greater than or equal to 5 and y is less than or equal to (2x-1)

However, Yanagida, in a dry etching method to etch a contact hole in a dielectric layer, teaches that $C_4F_8$ (cyclic saturated fluorocarbons ) and $C_5F_8$ (wherein x is equal to 5 and y is less than (2x-1)) may be mixed together during the etching step (col 5, lines 45-60, col 6, lines 52-65, col 7, lines 27-31)

Since Hung discloses the step of etching the dielectric layer using fluorocarbons gases, one skilled in the art would have found it obvious to perform Hung's etching step using an etching gas contains $C_4F_8$ and $C_5F_8$ gas as per Yanagida because Yanagida teaches that using both of the compounds having three or more carbon atoms yield more CF radicals per molecule to enable etching with a high etch rate (see abstract)

The limitation of claim 2 has been discussed above.

Regarding claim 4, Hung discloses that the dielectric/insulating film 14 is made of silicon dioxide or borophosphosilicate glass (col 2, lines 30-33)

Regarding claim 5, Hung discloses using argon gas in the etching step (col 5, Table 2)

Regarding claim 6, Hung discloses the step of forming an etch stop layer 12 on the surface of semiconductor substrate 10 and forming dielectric layer 14 on layer 12, the etch stop layer is made of silicon nitride, the etch selectivity etches the dielectric layer over the stop material (col 2, lines 22-37), which reads on the etching stopper film being made of material having an etching rate slower than etching rate of the insulating film when the dry etch process is performed by using the etching gas under a same etch condition.

6. Claims 3, 9, 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al. (US 6,380,096) in view of Yanagida (US 5,338,399) and further in view of Sakai et al (US 5,503,901)

Hung as modified by Yanagida has been discussed above. Unlike the instant claimed invention as per claims 3, 9, 13, Hung and Yanagida do not disclose the specific value of the partial pressure of $C_4F_8$ and $C_5F$ gases.

Sakai, in a method to improve etching selectivity, discloses that the gas supply means includes means for controlling the gas flow rate or the partial pressure of the $C_4F_8$ gas (col 5, lines 6-7).

Thus, Sakai serves as evidence that the gas partial pressure is a so-called "result effective variables". It has been held that the discovery of an optimum value for result

variables is within the purview of routine experimentation by the person of ordinary skill in the art. In re Boesch, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980)

7. Claims 7, 8, 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al. (US 6,380,096) in view of Yanagida (US 5,338,399)

Hung discloses an in situ oxide etch process particularly useful for a counterbore dual-damascene structure. This process comprises the steps of:

forming a semiconductor substrate 10 having a metal wiring 11 having upper surface exposed on a surface of the substrate 10 (col 9, lines 48-49 , fig. 9)

forming an etch stop layer 12 made of silicon nitride on the surface of the substrate 10 (col 2, lines 24-37), which reads on forming an etching stopper film made of a first insulating material on the surface of the semiconductor substrate

depositing a dielectric layer 14 (silicon oxide) on the layer 12/etching stopper film, the etch nitride, the etch selectivity etches the dielectric layer over the stop material (col 2, lines 19-25), which reads on depositing an insulating film on the etching stopper film, the insulating film being made of a second insulating material which contains si and ahs an etching resistance different from the etching stopper film

forming a resist pattern 98 over an dielectric layer 14 (silicon oxide), the resist pattern having an opening aligned over the metal wiring 11 (col 9, lines 1-9, fig. 5), which reads on covering a surface of an insulating film made of silicon-containing insulating material with a resist pattern having an opening superposed upon the metal wiring

etching the dielectric layer 14 using the mask pattern 98 as a mask and etching gas contains $C_4F_8$ and another fluorocarbon gas to form an opening/recess exposing the etching stopper film 12 at the bottom of the opening/recess (col 5, lines 30-50, fig. 6)

removing the resist pattern 98 /118 while the wiring 11 is covered by the etching stopper layer 12 (col 9, lines 30-32, fig.8 and fig. 9), which reads on removing the resist pattern under a condition that the metal wiring is covered with the etching stopper film

removing the exposed etching stop layer 12 to expose the metal wiring 11 (fig. 9)

filling/burying copper/conductive material in the opening/recess etched in the dielectric layer to form interconnect/conductive member contacting the metal wiring 11 (col 9, lines 45-49), the etch chemistry is available which etches the dielectric layer/second insulating material 14 but stops on the stop layer 12/first insulating layer (col 2, lines 21-24), which reads on the etching rate of the first insulating material is slower than an etching rate of the second insulating material when the dry-etching step is performed by the etching gas.

Unlike the instant claimed invention as per claim 7, Hung fails to disclose using an etching gas contains $C_4F_8$ and $C_xF_y$ gas to form a recess/opening (wherein x is greater than or equal to 5 and y is less than or equal to (2x-1)

However, Yanagida, in a dry etching method to etch a contact hole/opening in a dielectric layer, teaches that $C_4F_8$ (cyclic saturated fluorocarbons ) and $C_5F_8$ (wherein x is equal to 5 and y is less than (2x-1)) may be mixed together during the etching step (col 5, lines 45-60, col 6, lines 52-65, col 7, lines 27-31)

Since Hung discloses the step of etching the dielectric layer to form an opening using fluorocarbons gases, one skilled in the art would have found it obvious to perform Hung's etching step using an etching gas contains $C_4F_8$ and $C_5F_8$ gas as per Yanagida because Yanagida teaches that using both of the compounds having three or more carbon atoms yield more CF radicals per molecule to enable etching with a high etch rate (see abstract)

The limitation of claim 8 has been discussed above.

Regarding claim 10, Hung discloses that the dielectric/insulating film 14 is made of silicon dioxide or borophosphosilicate glass (col 2, lines 30-33)

8. Claims 11, 12, 14, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al. (US 6,380,096) in view of Yanagida (US 5,338,399)

Hung discloses an in situ oxide etch process particularly useful for a counterbore dual-damascene structure. This process comprises the steps of:

forming an etch stop layer 12/first film made of silicon nitride on the underlying layer 10 with a copeper wiring 11 (col 2, lines 16-18, fig. 5)

depositing a dielectric layer 14 (silicon oxide)/second film on the layer 12/first film (col 2, lines 19-25)

forming a mask pattern 98 over an dielectric layer 14/second film (col 9, lines 1-9, fig. 5), which reads on covering the second film with a mask pattern

etching the dielectric layer 14/second film using mask pattern 98 as a mask and etching gas contains $C_4F_8$ and another fluorocarbon gas (col 5, lines 30-50, fig. 6)

Unlike the instant claimed invention as per claim 11, Hung fails to disclose using an etching gas contains $C_4F_8$ and $C_xF_y$ gas (wherein x is greater than or equal to 5 and y is less than or equal to (2x-1)

However, Yanagida, in a dry etching method to etch a contact hole in a dielectric layer, teaches that $C_4F_8$ (cyclic saturated fluorocarbons ) and $C_5F_8$ (wherein x is equal to 5 and y is less than (2x-1)) may be mixed together during the etching step (col 5, lines 45-60, col 6, lines 52-65, col 7, lines 27-31)

Since Hung discloses the step of etching the dielectric layer using fluorocarbons gases, one skilled in the art would have found it obvious to perform Hung's etching step using an etching gas contains $C_4F_8$ and $C_5F_8$ gas as per Yanagida because Yanagida teaches that using both of the compounds having three or more carbon atoms yield more CF radicals per molecule to enable etching with a high etch rate (see abstract)

The limitation of claim 12 has been discussed above.

Regarding claim 14, Hung discloses that the dielectric/insulating film 14 is made of silicon dioxide or borophosphosilicate glass (col 2, lines 30-33)

Regarding claim 15, Hung discloses using argon gas in the etching step (col 5, Table 2)

***Conclusion***

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and 703 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308-0661.

LV
April 24, 2003